thereof, claim 29 has been amended to clarify features in light of the amendment of claim 1, and a new dependent claim 30 further defining features of the present invention have been presented.

At the outset, applicants note that applicants consider an interview with the Examiner may be helpful in resolving any outstanding issues, and although the present amendment is being submitted without benefit of an interview, applicants request the Examiner to contact the undersigned attorney to schedule an interview to resolve any outstanding issues, if considered appropriate.

With regard to the rejection of claims 1 and 2 under 35 U.S.C. §112, second paragraph, as being indefinite, it is noted by the present amendment, claim 1 has been amended in a manner which is considered to overcome the rejection under 35 U.S.C. §112, second paragraph, and claim 2 has been canceled, thereby obviating such rejection.

More particularly, claim 1 has been amended to recite the feature of at least one peak point at a region of the high ion energy and at a region of the low ion energy. Assuming arguendo that as illustrated in Fig. 4 of the drawings of this application, more than one peak point occurs in the low ion energy region and in the high ion energy region. Thus, the rejection of claims 1 and 2 under 35 U.S.C. §112, second paragraph, should now be overcome.

As to the rejection of claims 1, 4-7 and 24-29 under 35 U.S.C. 102(b) as being anticipated by US 5,352,324 issued to Gotoh et al (hereinafter Gotoh) and the rejection of claims 1, 2, 4 and 24-29 under 35 U.S.C. 102(e) as being anticipated by US 6,093,332 issued to Winniczek et al (hereinafter Winniczek), such rejections are traversed insofar as they are applicable to the present claims, and reconsideration and withdrawal of the rejections are respectfully requested.

With regard to the requirements to support a rejection under 35 U.S.C. 102, reference is made to the decision of In re Robertson, 49 USPQ 2d 1949 (Fed. Cir.

1999), wherein the court pointed out that anticipation under 35 U.S.C. §102 requires that each and every element as set forth in the claim is found, either expressly or inherently described in a single prior art reference. As noted by the court, if the prior art reference does not expressly set forth a particular element of the claim, that reference still may anticipate if the element is "inherent" in its disclosure. To establish inherency, the extrinsic evidence "must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." Moreover, the court pointed out that inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.

Turning first to the amendment of claim 1, applicants note that this claim has been amended to recite applying an rf bias voltage of a frequency so that ions of intermediate energy which promote etching reaction while providing poor directionality are reduced, and ions of high energy having a high directionality and ions of low energy which do not contribute to etching are increased, so as to have at least one peak point at a region of high ion energy and at least one peak point at a region of low ion energy for anisotropic etching, and the rf bias voltage to which a peak to peak voltage Vpp value larger than a Vpp value of a continuous rf bias voltage at which the same etch rate can be obtained is given, so as to have the high ion energy which is larger than a high ion energy of the continuous rf bias voltage, is applied to a stage on which a sample is placed independently of the generation of plasma, and on-off modulating the rf bias voltage at a region at which anisotropy is high before a region in which selectivity is high. Applicants note that the aforementioned features as now recited in claim 1 are clearly described in the specification and drawings of this application. That is, referring to the paragraph bridging pages 10 and 11 of the specification at page 10, line 17 to page 11, line 8,

there is described "when the frequency lies in a range from about 100 kHz to a few MHz, as shown by the 100 kHz characteristic in Fig. 4, the energy of ions has a saddle-shaped distribution including a peak 401 of high energy corresponding to the peak to peak amplitude Vpp of the rf bias and a peak 402 of low energy...the ions enter a region corresponding to the low energy peak 402 in Fig. 4...". As described in the paragraph at page 13, lines 9-21 of the specification, "The amplitude Vpp when the continuous wave bias is 60 W is 320 V and the amplitude Vpp when the on-off bias peak power is 300 W is 1,410 V. ...The energy of the ions can be increased by the on-off bias as compared with the continuous wave bias..." (emphasis added). As described in the paragraph at page 14, lines 14-23 of the specification, "Although ions having an intermediate energy promote the etching reaction, since the energy is low, their directionality is bad". Furthermore, as described in the paragraph bridging pages 14 and 15 of the specification at page 14, line 24, to page 15, line 10, "By setting the rf to 100 kHz or higher, as in this embodiment, the number of ions having an intermediate energy can be reduced, so that highly anisotropic etching can be realized. More specifically, in order to raise the degree of anisotropy of the etching, it is necessary to set the energy of the ions so as to have a distribution including and low peak points. Low ion energy does not contribute to etching and high ion energy has a high directionality. Effects of the on-off modulation of the rf bias prove their real worth for the first time when the rf bias is set to 100 kHz or higher, at which level the ion energy has a distribution including the high and low peak points." As described at page 36, lines 4-8, "By on-off modulating the rf bias voltage, which has a Vpp value larger than the Vpp value of a continuous rf bias voltage at which the same etch rate can be obtained, the degree of anisotropy can be improved without deteriorating the selectivity. Moreover, page 37, lines 1-7, "By on-off modulating the rf bias voltage at least in the steps of the first half, the region in which the anisotropy is high can be effectively used in the on-off modulation

and the etch profile can be improved." Thus, it is apparent that the amendment of claim 1 finds full support in the specification of this application. Moreover, with respect to newly added claim 30, it is apparent from Fig. 4 that the number of ions at at least one peak point in the high ion energy region and the low ion energy region is at least twice the number of ions in the intermediate ion energy.

Turning to Gotoh, applicants note that this patent discloses a high frequency electric power with 1 kHz or more, an average ion sheath thickness of plasma is changed intermittently between a thin state and a thick state, and absorption of a reacted seed and a repelling of a reacted product are repeated alternately so as to provide a high accuracy and high selectivity etching for producing a vertical machined shape. Applicants note the high frequency electrical power with 1 kHz or more disclosed in the Gotoh includes a high frequency electrical power containing a large amount of ions of intermediate energy showing a poor directionality even though etching reaction is promoted. In addition, Gotoh discloses an operation in which the turning-on and turning-off operations are controlled in a region requiring an increased selectivity ratio, i.e., a region (Si_3N4 and SiO_2) where an etched layer and a base layer are present together.

In contradistinction, the present invention provides an rf bias voltage having a frequency for decreasing ions of intermediate energy showing a poor directionality irrespective of promoting an etching reaction, and for increasing ions of high energy having a high directionality and for increasing ions of low energy which do not contribute to anisotropic etching, while providing at least one peak point at a region of low ion energy and at least one peak point at a region of high ion energy. Further, the rf bias voltage provides a value of Vpp higher than a value of Vpp of a continuous high frequency bias voltage capable of attaining the same etching speed so as to apply a higher energy ion than the high energy ion of continuous bias which is supplied independently apart from that for generating a plasma to a specimen

table on which a specimen is mounted. Additionally, the rf bias voltage is controlled for its on-off states between a region where a selectivity ratio is set high and a previous region showing a high anisotropic characteristic. The present invention provides a processing method in which a cause for adversely influencing the etching shape is further reduced in the case that turning-on and turning-off of the bias voltage for improving a vertical shape at the time of etching machining work are carried out, and applicants submit that such features are not disclosed by Gotoh in the sense of 35 U.S.C. 102, such that claim 1 and the dependent claims patentably distinguish thereover and should be considered allowable at this time.

Applicants note that irrespective of the Examiner's position concerning the peak to peak voltage Vpp and that Gotoh may have a saddle-shaped ion energy distribution, applicants submit that there is no disclosure of the recited features of claim 1 in the sense of 35 U.S.C. 102 and insofar as the Examiner contends that Gotoh inherently provides such features, applicants submit that as pointed out in the decision of In re Robertson, supra, inherency may not be established by probabilities or possibilities with there being no disclosure of a peak to peak voltage Vpp value being larger than a Vpp value of a continuous rf bias voltage in which the same etch rate can be obtained, noting that such is obtained with the on-off modulating of the rf bias at a region in which the anisotropy is high before a region which selectivity is high. As such, applicants submit that claim 1 and the dependent claims patentably distinguish over Gotoh in the sense of 35 U.S.C. 102, noting that there is no disclosure in Goth of the amount of ions at the at least one peak value of the low energy region and high energy region in relation to the intermediate energy region. Thus, applicants submit that all claims present in this application patentably distinguish over Gotoh et al in the sense of 35 U.S.C. 102, and should be considered allowable thereover.

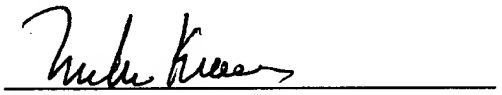
With regard to Winniczek, applicants note that this patent is directed to reduction of corrosion of a mask and utilizes an rf generator providing, for example, 4 MHz with the pulse frequency not being above 1 kHz with a high electrical power cycle and a low electrical power cycle being switched alternately. In accordance with Winniczek, polymer is accumulated at a surface of a mask at the time of a low electric power cycle. Thus, in accordance with Winniczek, the frequency of the rf generator is such as to include a high frequency electric power which contains a large amount of ions of intermediate energy promoting etching reaction and showing a poor directionality in the same manner as that of Gotoh. Applicants submit that Winniczek, like Gotoh, fails to disclose or teach the recited features of claim 1 and the dependent claims in relation to applying an rf bias voltage of a frequency so that ions of intermediate energy which promote etching reaction while providing poor directionality are reduced, and ions of high energy having a high directionality and ions of low energy which do not contribute to etching are increased so as to have at least one peak point at a region of high ion energy and at least one peak point at a region of a low ion energy for etching, wherein the rf bias voltage to which a peak to peak voltage Vpp value larger than a Vpp value of a continuous rf bias voltage at which the same etch rate can be obtained is given, so as to have the high ion energy which is larger than a high ion energy of the continuous rf bias voltage, is applied to a stage on which a sample is placed independently of the generation of the plasma, and on-off modulating the rf bias voltage at a region in which anisotropy is high before a region which selectivity is high. Additionally, it is readily apparent that irrespective of the contentions by the Examiner, Winniczek does not provide a disclosure of the claimed features of claim 1, nor the features of the dependent claims including claim 30, which provides that at least one peak point of the region of the high ion energy and the at least one peak point of the region of the low ion energy has a number of ions which is at least twice the number of ions in a region of

the intermediate ion energy. Such features are not disclosed by Winniczek in the sense of 35 U.S.C. 102 and applicants submit that claim 1 and the dependent claims patentably distinguish thereover and should be considered allowable at this time.

In view of the above amendments and remarks, applicants submit that all claims present in this application should now be in condition for allowance, and issuance of an action of a favorable nature is courteously solicited.

To the extent necessary, applicant's petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 01-2135 (520.36911CX2) and please credit any excess fees to such deposit account.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Please amend claim 1 as follows:

1. (twice amended) A method of treating a surface of a sample, comprising the steps of:

generating a plasma in a treatment chamber;

applying an rf bias voltage of a frequency ~~sufficient to form an ion energy distribution including a high peak point at which the ion~~ so that ions of intermediate energy which promote etching reaction while providing poor directionality are reduced, and ions of high energy ~~has~~ having a high directionality and ~~a low peak point at which the ion~~ ions of low energy ~~does~~ which do not contribute to etching are increased, so as to have at least one peak point at a region of high ion energy and at least one peak point at a region of low ion energy for anisotropic etching, and the rf bias voltage to which a peak to peak voltage Vpp value larger than a Vpp value of a continuous rf bias voltage at which the same etch rate can be obtained is given, so as to have the high ion energy which is larger than a high ion energy of the continuous rf bias voltage, is applied to a stage on which a sample is placed independently of the generation of the plasma; and

on-off modulating the rf bias voltage ~~to which a peak to peak voltage Vpp value larger than a Vpp value of a continuous rf bias voltage at which the same etch rate can be obtained is given~~ at a region in which anisotropy is high before a region in which selectivity is high.

Please cancel claims 2 and 5-7 without prejudice or disclaimer of the subject matter thereof.

Please amend claim 29 as follows:

29. (amended) A method according to claim 1, wherein ~~the ion energy distribution is~~ a saddle-shaped ion energy distribution is provided having the at least one peak point of the region of the low ion energy and the at least one peak point of the region of the high ion energy separated by a region of the intermediate ion energy.

Please add the following new claim:

--30. A method according to claim 1, wherein the at least one peak point of the region of the high ion energy and the at least one peak point of the region of the low ion energy has a number of ions which is at least twice a number of ions in a region of the intermediate ion energy.--